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Pteronotus rubiginosus (Wagner, 1843): first record of the bat family Mormoopidae in the Southeastern Region of Brazil

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Abstract
Pteronotus rubiginosus (Wagner, 1843) is a bat species belonging to the family Mormoopidae and has a wide distribution in the Amazon and Cerrado biomes in the Northern, Northeastern, and Central-Western regions of Brazil. In this study, we report the first record of this species from the state of Minas Gerais based on the capture of an individual using mistnets. With this record, we confirm the presence of *P. rubiginosus* in the Southeastern Region of Brazil, increasing to eight the number of chiropteran families there.

Keywords
Bats, Cerrado, Chiroptera, geographic distribution, mammals, mormoopids

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Introduction

In Brazil, the family Mormoopidae is represented by four species: *Pteronotus gymnonotus* (Wagner, 1843); *P. personatus* (Wagner, 1843); *P. alitonus* Pavan, Bobrowiec & Percequillo, 2018, and *P. rubiginosus* (Wagner, 1843) (Pavan et al. 2018). *Pteronotus rubiginosus* is the largest species in the family. It is widely distributed in the Neotropical region and in Brazil has been recorded in the Amazon and Cerrado, occurring in the Northern, Northeastern, and Central-Western regions of the country (Pavan 2014; Pavan et al. 2018).

The localities in which *P. rubiginosus* has been recorded in the Amazon are characterized by the presence of karstic landscapes (Ponzio 2017), forested sites (Reis et al. 2013, 2017), and savannic Cerrado enclaves in the biome (Pavan et al. 2018). Based on these records, *P. rubiginosus* is assumed to explore more open habitats in the Amazon region, such as the Amazonian savannas (Pavan et al. 2018). The diet of *P. rubiginosus* is strictly insectivorous and may include species of the orders Lepidoptera, Coleoptera, Hymenoptera, Diptera, Hemiptera, and Orthoptera (Rolfe and Kurta 2012; Reis et al. 2017), similar to bats of the families Molossidae and Vespertilionidae (Pedro et al. 1994). This species presents light to dark brown fur, small eyes, lance-shaped ears, rows of pads around a plate on the lower lip, wings not joined at the middle of the back, and a long tail with a well-developed uropatagium (Reis et al. 2013, 2017).

Ninety bat species have been recorded in Minas Gerais, belonging to seven families: Emballonuridae, Furipteridae, Molossidae, Natalidae, Noctilioni-

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dae, Phyllostomidae, and Vespertilionidae (Abreu et al. 2021). They are distributed in the three biomes, Atlantic Forest, Cerrado, and Caatinga. Most species inhabit natural environments, including cerrado savannas and caatinga (Reis et al. 2013, 2017), although some are very well adapted to urban environments (Perini et al. 2003; De Knegt et al. 2005; Filho et al. 2005; Barros et al. 2006; Reis et al. 2006; Evangelista et al. 2009; Oprea et al. 2009; Ferreira et al. 2010; Monteiro and Falcão 2010; Bruno et al. 2011; Silva and Anacleto 2011; Bruno 2014). Most studies that have addressed Chiroptera distribution and diversity in Minas Gerais have surveyed protected areas, thus, accentuating the lack of information on the distribution and ecology of this group in areas not protected by law (Tavares et al. 2010; Gregorin and Loureiro 2011; Gregorin et al. 2012, 2016; Velazco et al. 2014; Oliveira et al. 2021). In this study, we report on the presence of *P. rubiginosus* from Minas Gerais for the first time, thus extending the distribution area of this species and the family Mormoopidae to the Southeastern Region of Brazil.

Methods

The mustached bat species *Pteronotus rubiginosus* was recorded during a bat survey in northwestern Minas Gerais as part of the Program for Fauna Monitoring in the Areas under Recovery at the Queimado Hydroelectric Power Plant (HPP). This study was carried out in compliance with an environmental regulation linked to the second renewal of the operation license no. 302/2003 issued by the Brazilian Institute of the Environmental and Renewable Natural Resources (IBAMA). The HPP is located in the basin of the Rio Preto River, which is a tributary on the western bank of the São Francisco River, which is located in the Brazilian Distrito Federal (DF) and states of Goiás (GO) and Minas Gerais (MG). The basin is near the city of Unaí, and its reservoir is of great importance for controlling floods in this city.

The capture of the single specimen occurred in the municipality of Cabeceira Grande (MG). None of the sampling areas in this study are located in protected areas. We used the *P. rubiginosus* distribution polygon provided by Marsh et al. (2022) to illustrate the limits of this species' previously known distribution (Fig. 1).

Sampling in the area was conducted in quarterly campaigns, with eight consecutive nights of sampling per campaign from October 2018 to January 2022. We used 15 mist nets (12 × 3 m) set at ground level, along trails, over ponds and streams, near fruiting and flowering areas, and in potential diurnal shelters.

The captured specimen was weighed using a precision scale (0.01 g precision), and the external measures were taken using electronic calipers (precision 0.01 mm). Data on sex, age, reproductive condition, and body measurements (weight and length of the tibia and forearm) were obtained and used to categorize the specimen into juvenile or adult, according to the ossification of the epiphyses, following Kunz (1988). After this analysis, we marked the specimen with a numbered aluminum ring, placed on the forearm, and released at the site. For the taxonomic identification of the individual, descriptions in the literature were used (Lim and Engstrom 2001; Reis et al. 2007, 2011, 2013, Pavan 2014, 2017; López-Baucells et al. 2016; Díaz et al. 2016; Pavan et al. 2018).

Results

***Pteronotus rubiginosus* (Wagner, 1843)**
Figure 2

New record. BRAZIL – **Minas Gerais** • Cabeceira Grande; 15°59′04″S, 047°11′10″W; 843 m elev.; 14.IV. 2020; Michael Bruno obs.; mist nets; 1 ♀.

In the study area of the Fauna Monitoring Program in the Areas under Recovery at the Queimado HPP, one individual of *P. rubiginosus* was captured in a ground level mist net at approximately 10:00 pm. The vegetation in the area is native Cerrado savanna. After taking some external measurements, and completing the taxonomic identification, the specimen was released.

Identification. The forearm measured 61.6 mm length and its body mass was 20.5 g. *Pteronotus rubiginosus* is the largest species in the family (forearm 42–65 mm long). The captured individual was a female, not visibly pregnant nor lactating. Diagnostic characters for *P. rubiginosus* observed in our specimen include its dark brown color, small eyes, lance-shaped ears, rows of pads around a plate on the lower lip, wings not joined at the mid-dorsum, and a tail that exceeds the length of the uropatagium.

Pteronotus rubiginosus is easily separated from *P. alitonus* by acoustic, molecular, and morphological characters (e.g. cranial and dental) (Pavan et al. 2018), but it can be confused in the field with *P. alitonus*, due to the large overlap of measurements of external characters. However, as far as we know, *P. alitonus* is restricted to the Amazon and has no records in savanna areas (Pavan et al. 2018), and thus, together with the observed characteristics in the field, we assume that the individual captured in this study is *P. rubiginosus*.

Discussion

The occurrence of *Pteronotus rubiginosus* in Minas Gerais represents the first record of the family Mormoopidae in this state, as well as in the Southeastern Region of Brazil. The confirmation at the species level of the captured *P. rubiginosus* specimen was based on external characteristics and morphometric measurements, which were compared with data available in the literature (Lim and Engstrom 2001; Reis et al. 2007, 2011, 2013, 2017; Pavan 2014; López-Baucells et al. 2016; Díaz et al. 2016; Pavan et al. 2018). The 61.6 mm long forearm and 20.5 g body mass agree with literature records (Reis et al. 2007,

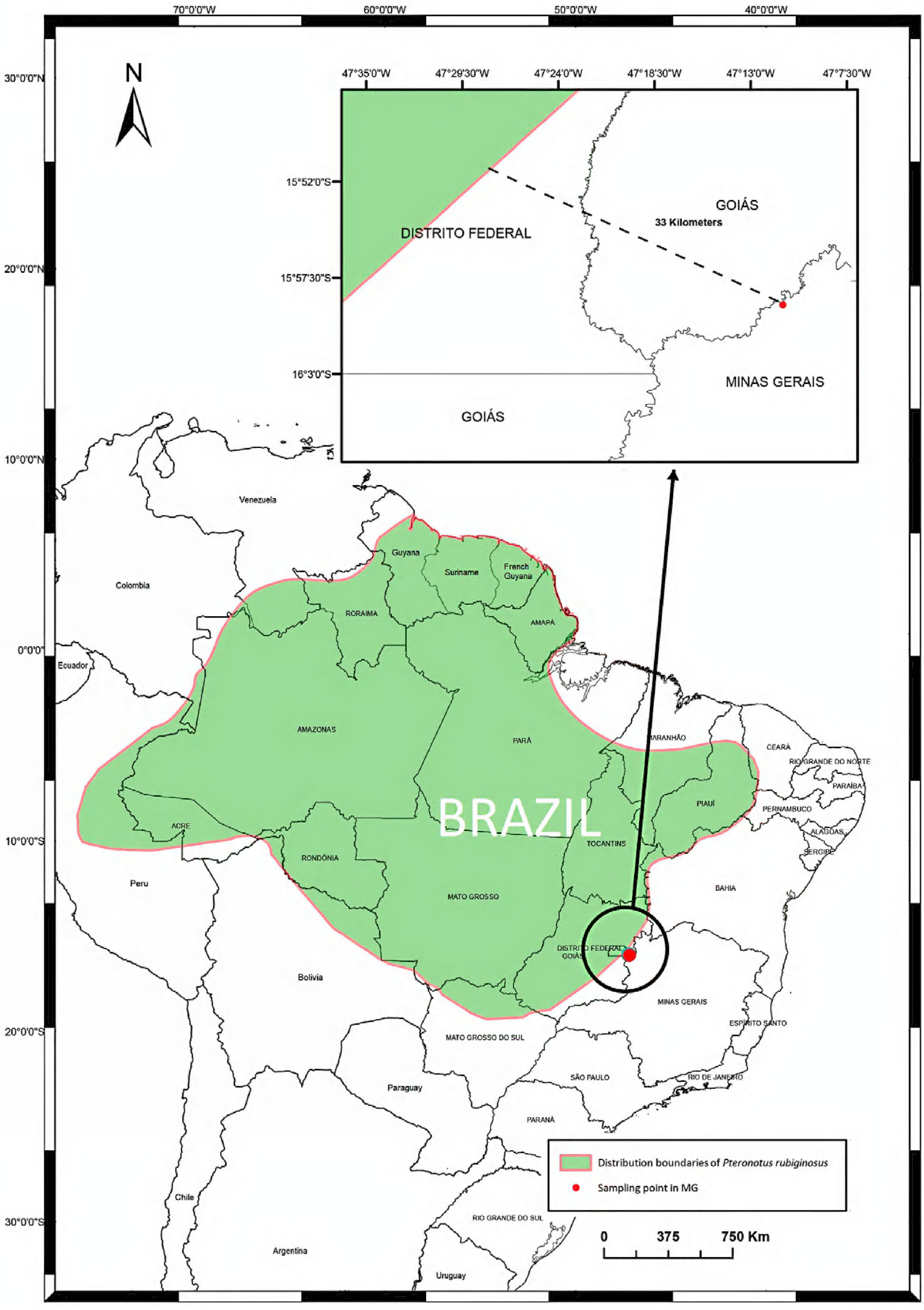

Figure 1. Distribution boundaries of *Pteronotus rubiginosus*, the new record is indicated by a red circle. Polygon adapted from Marsh et al. (2022). Brazilian states are in capital letters.

Figure 2. *Pteronotus rubiginosus* individual captured in the municipality of Cabeceira Grande, Minas Gerais state, Brazil.

2013, 2017; López-Baucells et al. 2016; Reis et al. 2017; Pavan et al. 2018).

Pavan et al. (2018) suggested that *P. rubiginosus* prefers to forage in more open and karstic landscapes in some Amazonian localities, as well as in the Cerrado of Brazil, which we corroborate in our current study. The same pattern was found by Oliveira et al. (2015), which suggests that this species is more active in areas of dense shrub vegetation than in riparian areas. Furthermore, it is important to highlight that *P. rubiginosus* is categorized as essentially cave-dwelling, meaning that the preservation of caves is needed to conserve of its populations (Guimarães and Ferreira 2014). It is also known that *P. rubiginosus* can share caves with other bat species (Reis et al. 2017), including *Carollia perspicillata* (Linnaeus, 1758), *Chrotopterus auritus* (Peters, 1856), *Desmodus rotundus* (E. Geoffroy, 1810), *Glossophaga soricina* (Pallas, 1766), and *Micronycteris megalotis* (Gray, 1842) (Cajaiba 2014). According to Hutson et al. (2001), the greatest threats imposed on chiropterans and their shelters in the Neotropical region are deforestation, agricultural activities, mining, and hematophagous bat control programs. Hutson et al. also suggested that insect availability has a greater influence on the presence of this species than the degradation of the vegetation itself.

To date, 90 species have been recorded in Minas Gerais, making it the most species-rich state for bats in southeastern Brazil (Tavares et al. 2010; Abreu et al. 2021), but no record of *P. rubiginosus*, or any mormoopid bat species, exists in this region, according to previously published literature (Pavan et al. 2018). The state of Espírito Santo is the second richest, with 86 bat species (Abreu et al. 2021), followed by São Paulo, with 79 species (Garbino 2016) and Rio de Janeiro, with 77 species (Peracchi and Nogueira 2010). Our new record expands the confirmed species in Minas Gerais to 91. The fact that this is the first record in Minas Gerais, suggests that *P. rubiginosus* is rare in this state (Reis et al. 2007; Guimarães and Ferreira 2019).

Although *P. rubiginosus* is not in official lists of endangered species (COPAM 2010; MMA 2022; IUCN 2022), our new record helps to better define which areas still have knowledge gaps and contributes to a better knowledge of the state fauna. Nevertheless, our new record is important, as the region where the bat was observed is considered a very high priority area for biodiversity conservation in Minas Gerais (MMA 2018), and it could lend support to the creation of new protected areas.

The diversity of bats in Minas Gerais is still insufficiently known, especially because most bat inventories are concentrated in federal, state, and municipal protected areas, such as studies conducted in the Private Natural Heritage Reserve Feliciano Miguel Abdala (Aguiar and Marinho-Filho 2004), Serra do Caraça Reserve (Falcão et al. 2003), Rio Doce State Park (Tavares 2013), APA Carste of Lagoa Santa (Herrmann et al. 1998), EPTEA Mata do Paraíso (Nascimento et al. 2013), and municipal parks in Belo Horizonte (Bruno et al. 2011; Bruno, 2014). In addition, there are considerable gaps in surveying in the state, with one of the most representative being the northwestern region, where our observation was made (Bernard et al. 2011; Aguiar et al. 2020). Native vegetation areas that are not protected by law may suffer from deleterious effects resulting from development. Hydroelectric power plants result in loss of habitat, fragmentation, and edge effects (Benchimol and Peres 2015), which are among the main threats to bat populations (Fenton et al. 1992; Meyer and Kalko 2008). As noted by Bobrowiec and Tavares (2017), bat communities take a long time to recover from the impacts of hydroelectric power plants, as seen in the hundred-year-old areas around Panama's Lake Gatún, where bats species have not stabilized and species are slow to reestablish.

Our study was the result of a record obtained in an

environmental consulting service, which is significant because a large volume of data is obtained by such studies, often from areas that have never been scientifically sampled. Thus, it is of utmost importance to publish the results of consultancy work in peer-reviewed scientific articles, especially the results of studies undertaken in areas that are not protected by law, and thus are more threatened. Companies with data publication initiatives, such as Minas Gerais Energy Company (CEMIG), should be followed by various segments, thus providing researchers and consultants the opportunity to publish information about the fauna, flora, and environments associated with different types of projects.

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Authors' Contributions

Visualization: MB; FF. Writing – original draft: MB. Writing – review and editing: MB, FF.

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